Space Weather Technical Forecast

Issued on Thursday 27 March 2025 at 13:17 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: G1/Minor storms likely, decreasing chance of G2/Moderate geomagnetic storms day 1. Chance of M-class flares (R1-R2; Minor-Moderate radio blackouts) throughout.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity reached Moderate levels, due to an isolated M2.0-flare from AR4043 in the northeast at 27/0037 UTC. There are currently five sunspot regions on the Earth-facing solar disc, all of which are small and magnetically simple. AR4043 is the most significant region, a relatively small but slowly growing bipolar region in the northeast, now classified as a Dai/beta-gamma. A new simple and currently unnumbered, bipolar region is developing near the northeast limb classified as Dao.

No clear Earth-directed CMEs were observed in the past 24 hours.

Solar Wind / Geomagnetic Activity: Solar wind parameters, as measured by DSCOVR at L1, were indicative of the arrival of a high speed stream (HSS) due to connection to CH25/+. Speeds were initially at slightly elevated levels around 400 km/s, these rose through the period, reaching strong levels during the UTC evening and rose to very strong levels during the morning of the 27th, peaking at 870 km/s at 27/0730 UTC. Density has been below average. The Interplanetary Magnetic Field, Bt, started at strong levels around at 28nT at 26/1200 UTC and has been on a gradual decline to current moderate levels of around 8nT. The north-south component, Bz, started initially fluctuated between strong positive (northward) and negative (southward) orientation, ranging from, -23nT to +19nT. From around 26/1800 UTC the north-south component became mainly weak, slightly favouring a positive (northward) orientation. The phi angle was predominantly positive (away from the sun). Geomagnetic activity was at predominantly Active to G1/ minor geomagnetic storm levels (Kp 3-5), with two G2/Moderate Storm intervals 26/1500-1800 UTC and 26/1800-2100 UTC.

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV) at GOES18 was at background levels. High energy electron flux (greater than 2 MeV) at GEO was at background to moderate levels with a peak level of 168 pfu at 26/1315 UTC . The 24-hour fluence was below the Active threshold. The observed integrated pfu was 1.8e6 at 27/0000 UTC.

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Space Weather Technical Forecast

Four-Day Space Weather Forecast Summary

Solar Activity: Low to moderate solar activity is expected, with a chance of further isolated M-class flares, most probably from the active region in the northeast of the solar disc AR4043.

Solar Wind / Geomagnetic Activity: No clear Earth-directed CMEs feature in the forecast, though an eruption on 25th may give a slight chance of a glance on day 3 (29 Mar), although this is low confidence.

Solar winds are currently very strong, around 800km/s, due to the HSS related to the unusually prominent positive coronal hole feature CH25 which dominates a large portion of the southern hemisphere. Solar winds gradually waning towards slightly elevated levels on days 3 and 4 (29 and 30 Mar).

Active to G1/Minor storm (Kp4-5) geomagnetic levels, with a chance of further G2/Moderate (Kp6) storms at first on day 1 (27 Mar) due to coronal hole influences, before easing later day 3 into day 4 (29/30 Mar), becoming generally Quiet to Unsettled (Kp2-3) by the end of the period.

Energetic Particles / Solar Radiation: High energy proton flux is expected to be at background levels, with a a negligible chance of enhancement from any larger flares. High energy electron flux is expected to continue at largely background to moderate levels until later in the period, when it may become diurnally high. There is a associated chance that electron (1e8 integrated pfu) fluence could rise above the Active threshold towards the end of the period in response to rising flux levels.

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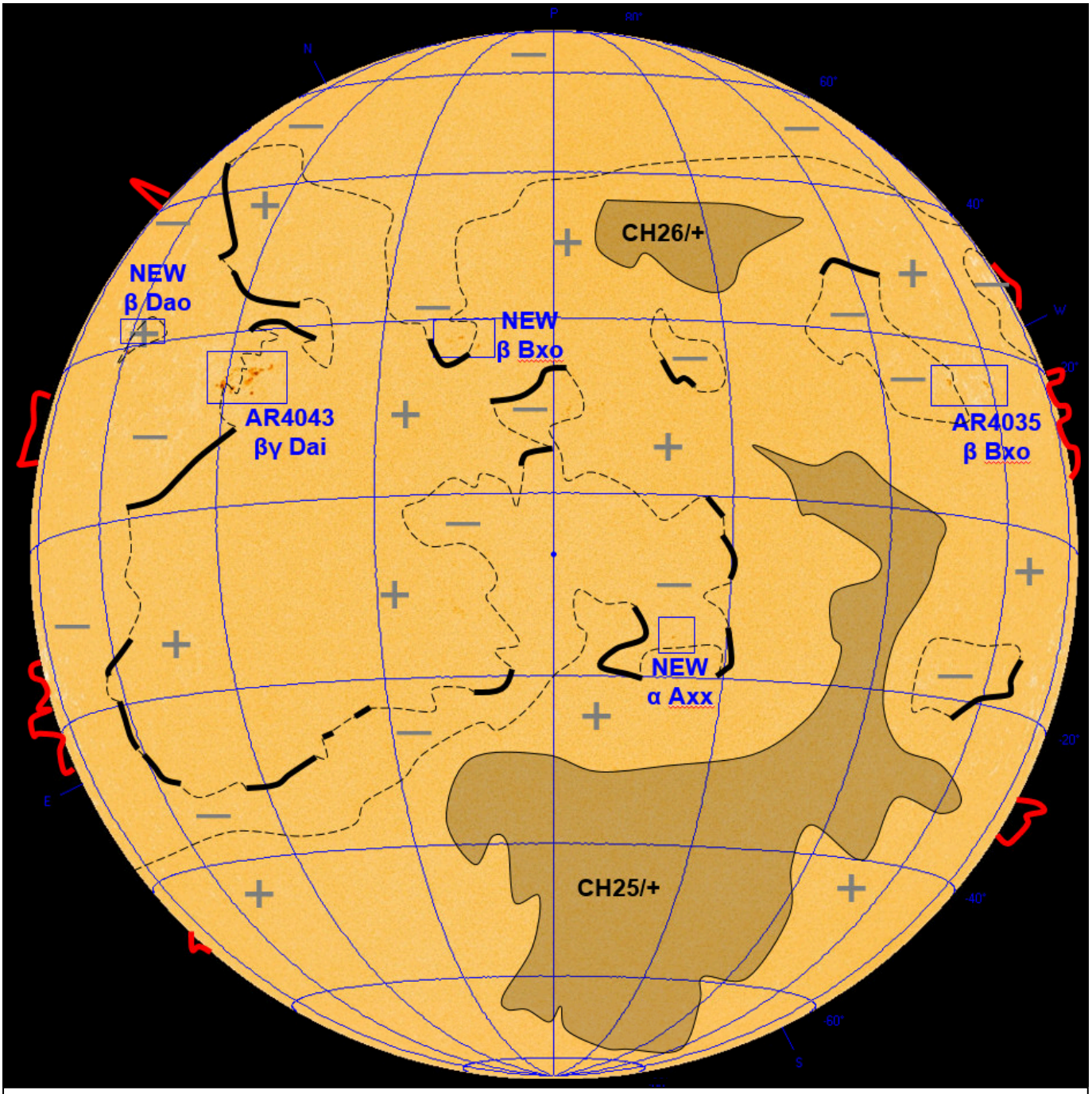
Figure 1: MOSWOC Solar Synoptic Map valid 27/0800UTC



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms

There are no clear Earth-directed CMEs in the forecast at present, though an eruption on 25th may give a slight chance of a glance on day 3 (29 Mar), although this is low confidence.

Solar winds have exceeded 800 km/s at times from 27/0428 UTC. This also occurred on the previous rotation. MOSWOC Enlil output is considered to be providing good guidance, with a weighting toward persistence given a similar structure to this coronal hole was observed on the last rotation. Solar winds starting the guidance period at strong to very strong levels on day 1 (27 Mar), due to the HSS related to the unusually prominent positive coronal hole feature CH25 which dominates a large portion of the southern hemisphere. Solar winds gradually waning towards slightly elevated levels on days 3 and 4 (29 and 30 Mar). During the first day of the period (27 Mar) Active to G1/Minor storm (Kp4-5) geomagnetic levels will continue, with chance of further G2/Moderate (Kp6) storms at first on day 1 (27 Mar) due to coronal hole influences. During the rest of the period geomagnetic activity will most likely ease through day 3 into day 4 (29/30 Mar), becoming generally Quiet to Unsettled (Kp2-3) by the end of the period.

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	Yes	90	70	30	10
Strong	G3	No	10	5	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R⊙ (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed (km/s)	Estimated Arrival Time (UTC)	Comments
25/1741 UTC	Partial	Filament eruption	SE	1300 km/s	29/0600 UTC	Low confidnce as modelled on limited availability of imagery.

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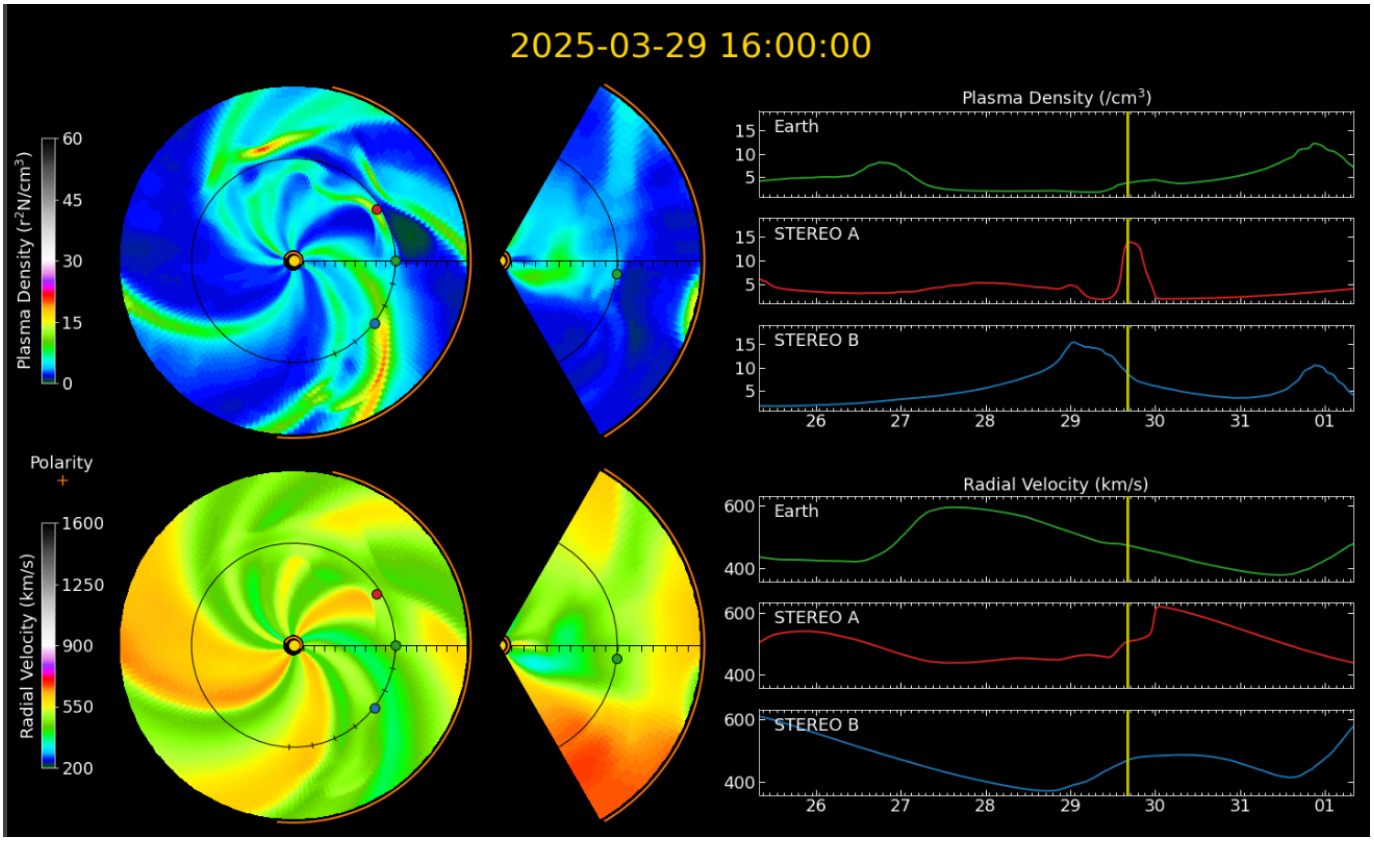
Figure 2: MOSWOC ENLIL with a couple of CMEs departing the western limb wrt Earth.



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Radio Blackouts - X-Ray Flares

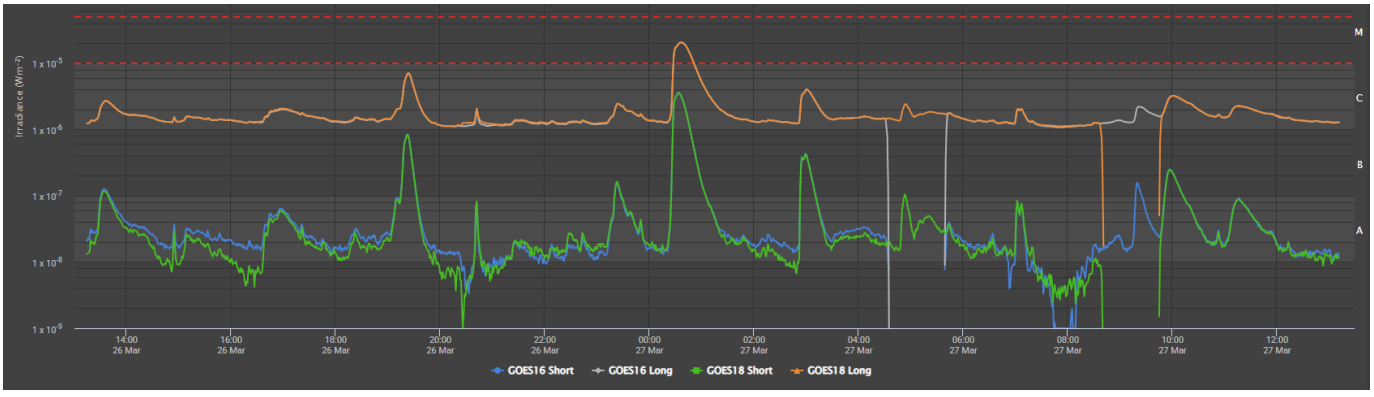
Solar activity reached Moderate levels, due to an isolated M2.0-flare from AR4043 in the northeast at 27/0037 UTC.

There are currently five sunspot regions on the Earth-facing solar disc, all of which are small and magnetically simple. AR4043 is the most significant region, a relatively small but slowly growing bipolar region in the northeast, now classified as a Dai/beta-gamma. A new simple and currently unnumbered, bipolar region is developing near the northeast limb classified as Dao.

Low to moderate solar activity is expected, with a chance of further isolated M-class flares. Probabilities for M-class flares, in the table below, have been raised a little, later in the guidance period, in anticipation of a couple of returning active regions which should rotate into view across the eastern limb.

X-Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**R1-R2 (M Class)**	Yes	30	30	40	50
Very Active	**R3-R5 (X Class)**	No	1	1	1	5

Figure 3: GOES 18/16 X-ray Flux at GEO with several C-class flares and one reaching M-class from AR4043.



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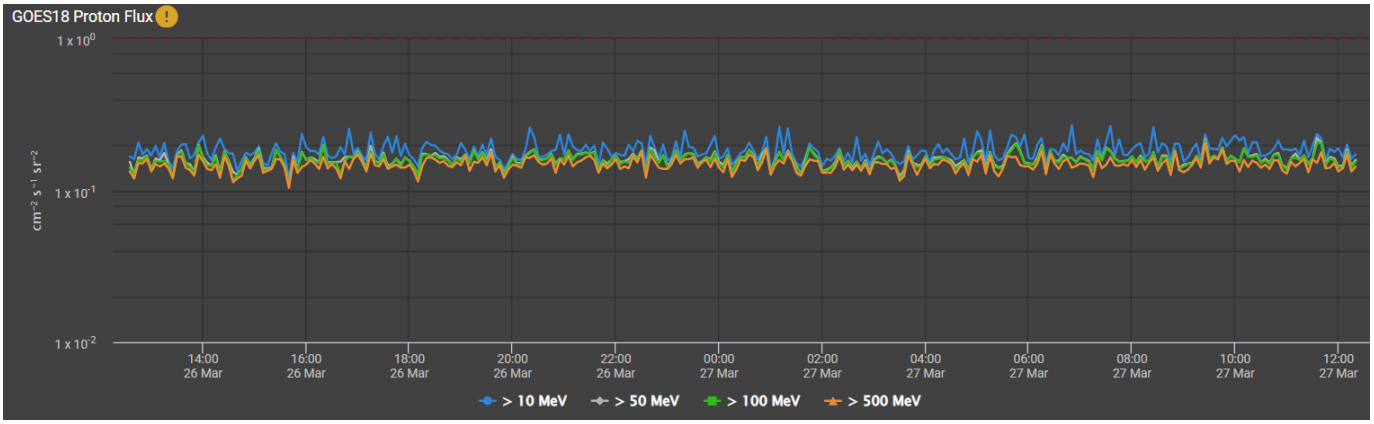
Solar Radiation Storms (High Energy Protons)

GOES18 high energy (>10MeV) proton flux was at background levels. Proton flux is expected to remain at background levels, with a negligible chance of enhancement due to the current lack of large, complex spot groups on the Earth facing disc.

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	1	1	1	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 4: GOES18 Proton Flux



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High Energy Electrons (≥ 2MeV)

GOES16 High energy (>2MeV) Electron flux has been at background to moderate levels. With a chance of enhanced geomagnetic activity due to the HSS from CH25+ at the start of the period, the Van Allen belt is likely to be suppressed away from GEO and electron flux is therefore expected to remain at background to moderate levels for the first couple of days. However, as the geomagnetic activity wanes on days 3 and 4 (29 and 30 Mar), the charged electron belts should expand back towards GEO, with a probable significant rise in the flux of high energy electrons.

Electron (1e8 integrated pfu) fluence should remain below the Active threshold throughout the period. MOSWOC REFM output is indicating a chance that electron fluence could rise above the Active threshold towards the end of the period and is considered reasonable guidance with moderate confidence.

GEO Electron Environment	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ 1×10^{8}	No	1	1	20	50
Very Active	≥ 2 MeV ≥ 1×10^{9}	No	1	1	1	1

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Figure 5: REFM Electron Fluence and GOES16 Electron Flux

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